

# Renewable Energy Trends Impacting the Federal Sector



Presentation to:  
Renewable Working Group

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# Agenda

**I. Introduction**

**II. Renewable Energy (RE) Technology Outlook**

**III. RE Market Factors**

**IV. RE Options for the Federal Sector**

# Agenda

## I. Introduction

## II. Renewable Energy Technology Outlook

## III. RE Market Factors

## IV. RE Options for the Federal Sector

## **NCI was retained by NREL to support FEMP as it works to meet Federal sector renewable energy consumption targets.**

- The Federal government appears to be on track to meet its 2005 renewable energy procurement targets (the equivalent of 2.5% of electricity use) that were established under Executive Order (EO) 13123.
- As with energy efficiency targets, Federal Energy Management Program (FEMP) is charged with assisting the Federal sector with compliance with EO 13123.
- The National Renewable Energy Laboratory (NREL) has been providing analytical support to FEMP in this effort and is currently working with FEMP and other Federal sector stakeholders in developing renewable energy targets beyond 2005.
- Based on previous work completed in this area, Navigant Consulting, Inc. (NCI) was retained by NREL to provide an outside perspective on key renewable energy technologies and market issues, as well as trends relevant to the Federal sector.
  - This work will serve as one of several inputs to the process of setting future renewable energy targets for the Federal sector.

**Although the Federal goals include renewable energy generally, the NCI work focused on electricity generation.**

# Agenda

I. Introduction

**II. Renewable Energy Technology Outlook**

III. RE Market Factors

IV. RE Options for the Federal Sector

## NCI reviewed a wide range of RE resources and technologies.<sup>1</sup>

Renewable Energy Resource <sup>1</sup>	Conversion Option	Technology Type
Solar	Photovoltaics	Flat plate: crystalline silicon and thin films
		Concentrating PV
		Nano solar cells
	Solar Thermal Electric	Parabolic trough
		Power tower
		Dish Stirling
Wind Power		Onshore – grid sited (wholesale generation)
		Onshore – customer sited (“behind the meter”)
		Offshore
Geothermal Power		Flash
		Binary
		Hot dry rock
Ocean Energy		Wave
		Tidal barrage, tidal and marine current
		Ocean Thermal (OTEC)

1. This report only addresses electricity generation from renewable energy.

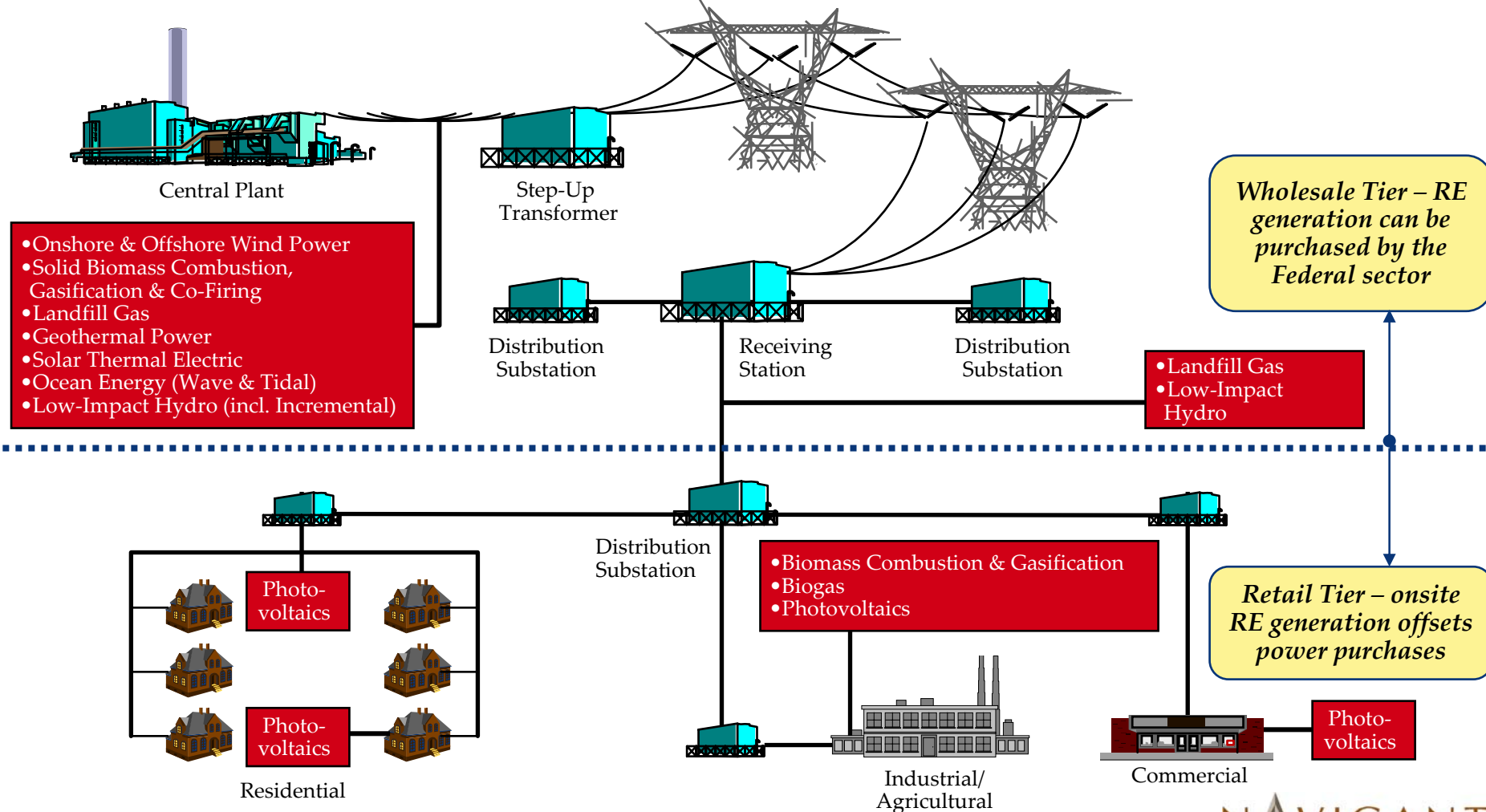
## NCI reviewed a wide range of RE resources and technologies.<sup>1</sup> (continued)

Renewable Energy Resource <sup>1</sup>		Conversion Option	Technology Type
Solid Biomass	<ul style="list-style-type: none"><li>• Wood</li><li>• Wood waste</li><li>• Agricultural residues</li><li>• Bagasse</li><li>• Food processing residues</li><li>• Animal wastes</li><li>• Municipal Solid Waste (MSW)</li><li>• Energy crops</li></ul>	Direct Combustion	Biomass-only Rankine (steam) Cycle
			Co-firing Rankine Cycle (primarily coal)
		Gasification	Biomass-only Rankine Cycle
			Biomass-only GT/IGCC
			Biomass-only IC Engine (ICE)
			Co-firing (coal or NG Rankine, IGCC, CCGT)
			Co-gasification of biomass and coal
		Liquefaction (Pyrolysis)	Biomass-only Pyrolysis (Rankine, GT, ICE)
		Gaseous Biomass	<ul style="list-style-type: none"><li>• Landfill gas</li><li>• Methane from waste and wastewater treatment (“biogas”)</li></ul>
Biomass-only GT, CCGT, ICE			
Biomass-only Fuel Cell			
Hydropower			Conventional
			Low-Impact, including incremental

1. This report only addresses electricity generation from renewable energy.

Note: GT = gas turbine, CCGT = gas turbine combined cycle; IGCC = integrated gasification combined cycle, ICE = internal combustion engine.

Some RE technologies compete within the wholesale power market, while others primarily offset higher-priced retail power.

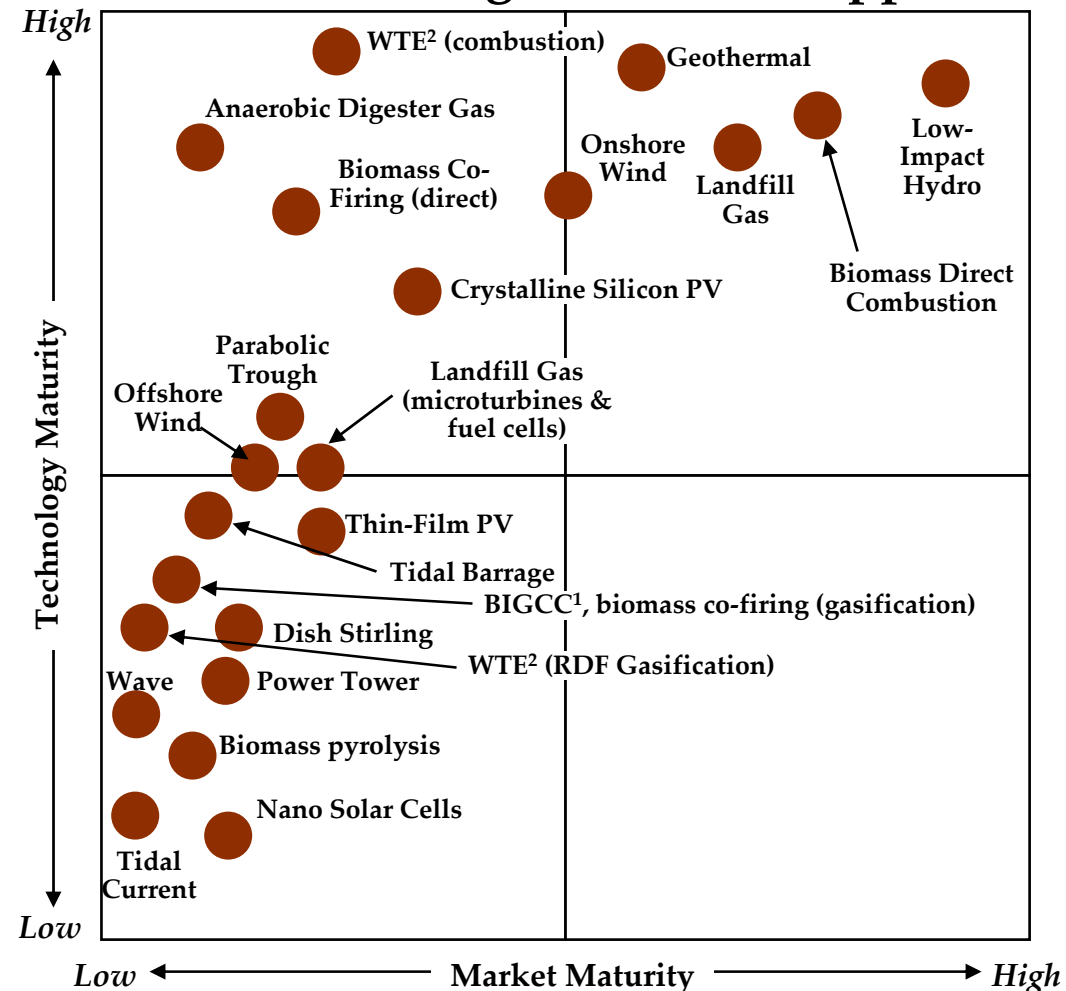


## Many RE technologies are undergoing rapid change, but future developments remain uncertain for others.

- Among the commercially available options, wind power and PV are expected to experience the greatest cost reductions.
  - Onshore wind power could become competitive with conventional options on a levelized cost of energy basis by 2010 (without incentives), and can be competitive today with incentives such as the Production Tax Credit (PTC)
  - Offshore wind power development will depend on the technical success of ongoing efforts in Europe and if early projects in the U.S. can be successfully developed. Even if successful, costs are expected to be ~80% higher than for onshore systems despite access to higher wind speeds.
  - PV will be more expensive than retail power in most areas of the country until beyond 2010 without incentives, but many state buy-downs improve PV economics.
- Biomass direct combustion, landfill gas/biogas, geothermal power and low-impact hydropower are all relatively mature, and are not expected to change much in the study period.
- Biomass co-firing is also relatively mature, but could experience relatively rapid deployment due to RPS eligibility in some states.
- Biomass gasification combined cycle technology is still being demonstrated and the timing of progress towards commercial status is uncertain.
- Marine energy is still largely in the RD&D stage and future costs remain highly uncertain.

## Technology and/or market maturity for several renewable energy technologies is still low and could benefit from government support.

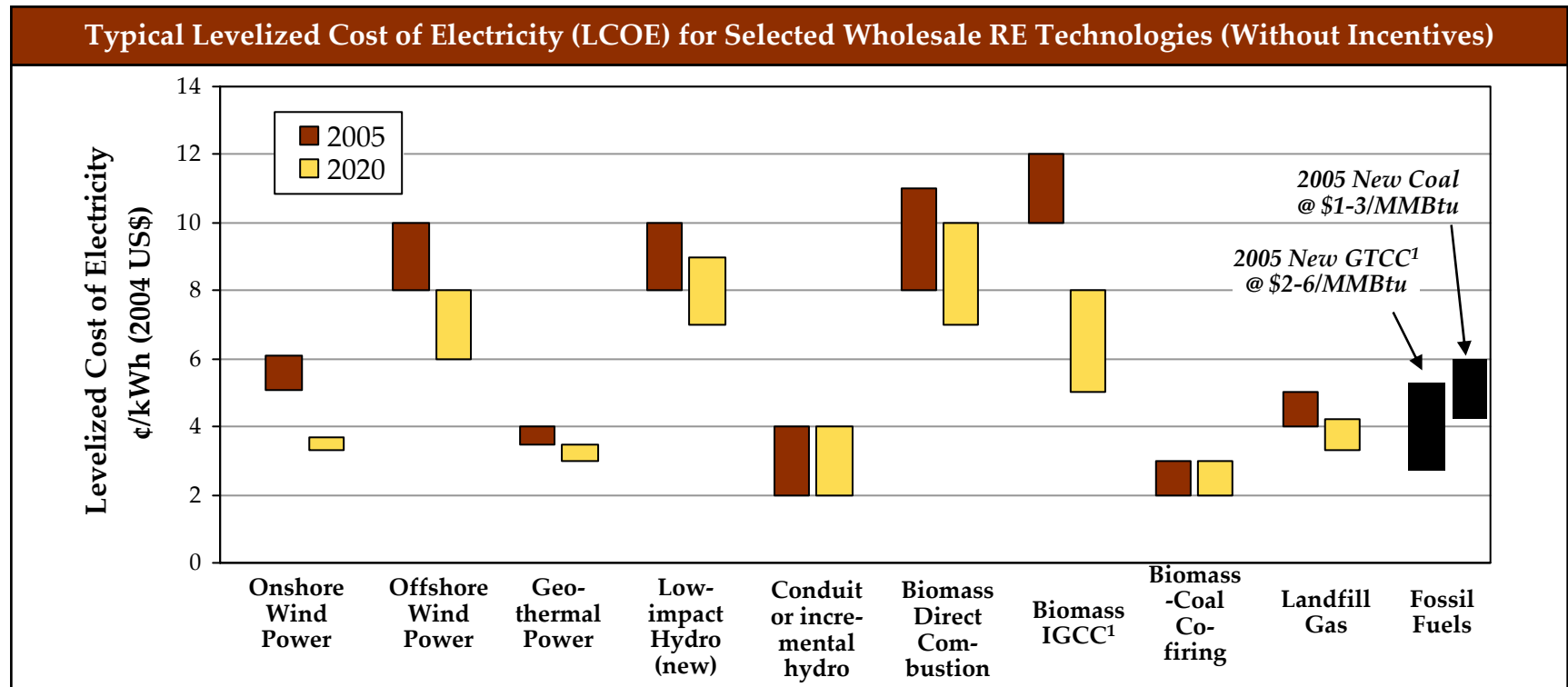
- *Technology maturity* describes the potential for performance and/or cost reductions.
- *Market maturity* describes the existence of well established business models and the degree of saturation of the market potential.
- Note that while some technologies are relatively mature, other barriers have prevented them from widespread deployment (e.g., siting & environmental concerns with waste-to-energy)



1. Biomass integrated gasification combined cycle  
2. WTE = waste to energy, RDF = refuse derived fuel

Source: Navigant Consulting, Inc, 2004.

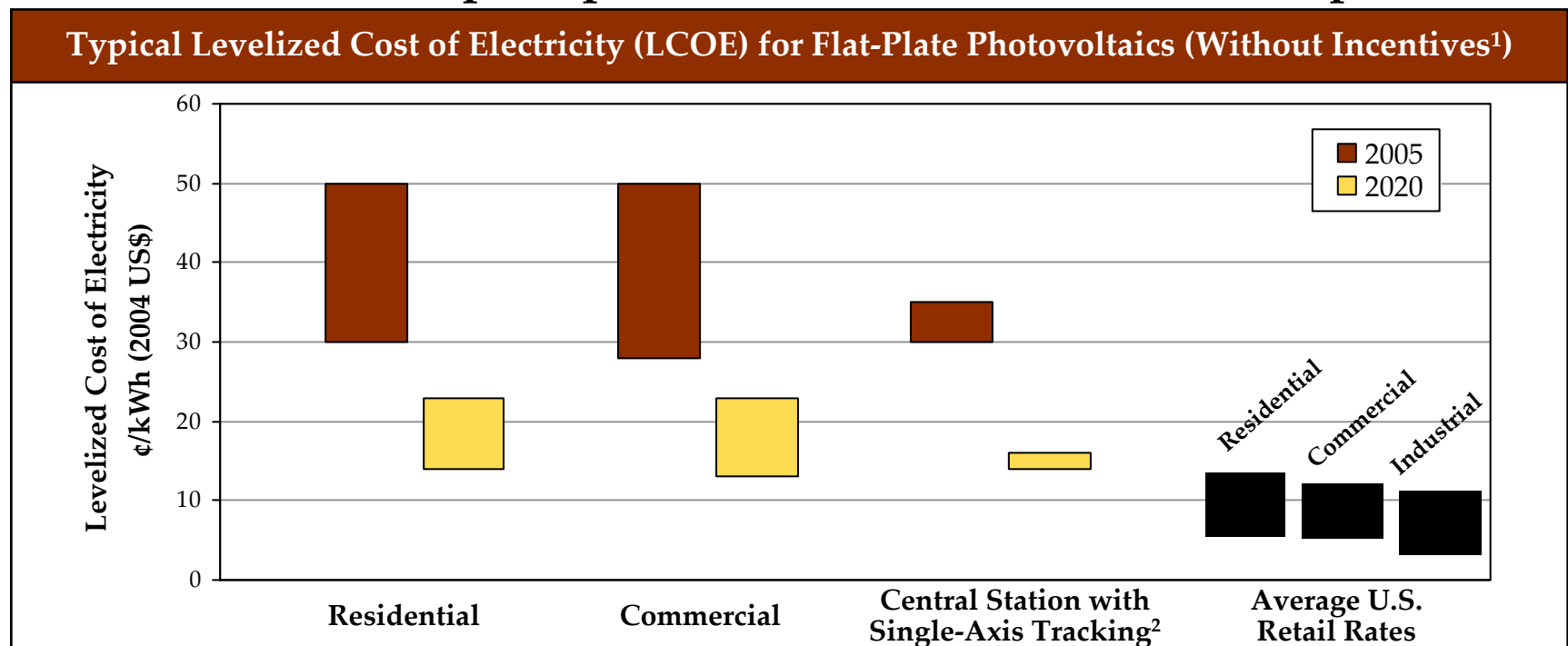
Some wholesale RE technologies are competitive with new fossil generation; others will be approaching competitiveness by 2020.



Notes:

- Values represent a range of analyses and should be considered “typical” for the resource identified (e.g. on-shore wind is a Class 4 wind site).
  - Co-firing assumes credit is taken for the displaced coal and that a separate feed system is used for the biomass, as would be needed with a PC boiler firing biomass >2% of heat input.
  - Biomass cases would look more attractive for onsite cogeneration, possibly by as much as 3¢/kWh.
  - Landfill gas assumes gas collection system already in place.
1. IGCC = integrated gasification combined cycle; GTCC = gas turbine combined cycle.






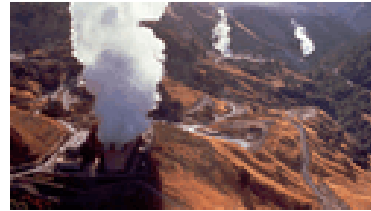
**PV, a leading onsite power option, is expected to remain above average retail rates in the near-term. However, real-time pricing and other methods to value on-peak power should make PV more competitive.**



**Notes:**

- Values represent a range of analyses and should be considered “typical” for the resource identified.
  - Range for residential and commercial includes high and low insolation. Range for central station is only for high insolation.
  - Retail rates are for 2002 and exclude Alaska and Hawaii.
1. A 10% Federal Investment Tax credit and Five Year Accelerated Depreciation, which have been available for many years and will likely continue to be available, have been included for the Commercial and Central Station cases.
  2. Although it may be more appropriate to compare central station PV to wholesale, power, it is shown here for comparison to other PV options.

**For most of the renewable energy technologies, large corporations are staking out strong positions to capitalize on growth opportunities.**

Examples of Large Corporate Players in Renewable Energy			
<b>Photovoltaics</b> 	<ul style="list-style-type: none"> <li>• Sharp</li> <li>• BP Solar</li> <li>• Kyocera</li> <li>• Shell Solar</li> <li>• Sanyo</li> <li>• RWE Schott Solar</li> <li>• GE</li> <li>• Mitsubishi</li> </ul>	<b>Low-Impact Hydropower</b> 	<ul style="list-style-type: none"> <li>• GE Hydropower</li> <li>• ABB Alstom Power</li> <li>• VA Tech</li> </ul>
<b>Wind Power</b> 	<ul style="list-style-type: none"> <li>• Vestas/NEG Micon</li> <li>• Enercon</li> <li>• GE Wind</li> <li>• Mitsubishi</li> <li>• FPL Energy</li> <li>• National Wind Power</li> <li>• Shell Wind</li> <li>• ABB</li> </ul>	<b>Solar Thermal Electric</b> 	<ul style="list-style-type: none"> <li>• Solargenix Energy</li> <li>• Gamesa</li> <li>• Industrial Solar Technology</li> <li>• FPL Energy</li> <li>• Constellation</li> <li>• SMUD<sup>3</sup></li> </ul>
<b>Biomass Power</b> 	<ul style="list-style-type: none"> <li>• Foster Wheeler</li> <li>• DTE Biomass</li> <li>• Caterpillar<sup>1</sup></li> <li>• Waukesha<sup>1</sup></li> <li>• Solar Turbines<sup>1</sup></li> <li>• All pulp &amp; paper co's<sup>2</sup></li> </ul>	<b>Geothermal</b> 	<ul style="list-style-type: none"> <li>• Calpine</li> <li>• Caithness Energy</li> <li>• Ormat</li> <li>• Mitsubishi</li> <li>• Toshiba</li> <li>• Fuji</li> </ul>

1. Suppliers of engines and gas turbines for landfill gas and biogas projects
2. Owners of most existing biomass power capacity in North America

3. Sacramento Municipal Utility District

## Market conditions for renewable energy technologies in the United States are as varied as the technologies themselves.

### Wind

- Wind is expected to be the leading technology in terms of new additions over next 10 years.
- Additions of 1,000-2,000 MW per year in the United States are expected, assuming continuing policy support over the next 10 years, with off-shore wind beginning to see initial applications after 2008.
- Production tax credits and RPS requirements are expected to remain drivers of this growth.

### PV

- Continued robust growth is expected, but economics with incentives today are 2-3 times as expensive as grid power (based on average prices). Absent any breakthroughs, PV is expected to require incentives and RPS requirements in the near term, except maybe in some locations with high on-peak prices.
- Larger central station applications often need to compete with wholesale power, and therefore applications have been minimal to date.

### Biomass

- Landfill gas now leads in current opportunities, along with organic growth in bio-based industries.
- Large potential for co-firing and gasification, but market size and timing are uncertain.
- Significant growth (%) expected in anaerobic digestion systems, but as a niche opportunity.

### Low-Impact Hydro

- Significant untapped potential remains, but the U.S. market is expected to be small, absent major changes to the permitting and licensing process.

### Geothermal

- Limited development expected absent changes to incentive programs:
  - The recent expansion of the Federal PTC to include geothermal power is not likely to impact the market since the PTC expires at the end of 2005, which doesn't give enough time to impact new projects.

### Solar Thermal Electric

- Renewed interest in the Southwest U.S., but high initial cost will have to be overcome with larger production volumes for technologies such as parabolic troughs, dish Stirling, or Power Towers.
- A potential advantage relative to other solar technologies is the ability to incorporate storage to address intermittency issues.

## **The main report provides detailed reviews of the following technologies.**

- Solar Power
  - Flat plate photovoltaics
  - Concentrating photovoltaics
  - Nano solar
  - Solar thermal electric
- Wind Power (onshore and offshore)
- Geothermal Power
- Marine Energy
  - Wave
  - Tidal
- Low-Impact Hydropower
- Solid biomass power (direct combustion, gasification, co-firing)
- Landfill gas/biogas

**The slides that follow show as examples, summaries for wind power and biomass, and a detailed profile of PV.**

## Wind power is well established and onshore projects are approaching cost competitiveness with conventional power options.

<b>Applications</b>	<ul style="list-style-type: none"> <li>Onshore wind power technology is mature and economics are approaching competitiveness with conventional power options.</li> <li>Offshore wind power technology has yet to be implemented in the United States, and is still in the early commercial stage in Western Europe. As of the end of 2003, only 529 MW of offshore wind was installed.</li> </ul>
<b>Technology</b>	<ul style="list-style-type: none"> <li>Although relatively mature, steady technology development/improvements are expected to lead to improved performance.                             <ul style="list-style-type: none"> <li>Capacity factors are expected to increase by approximately 7% over the next ten years.</li> <li>1.5MW is now on the low end of the range and tower heights of 70-80 meters are increasingly common.</li> </ul> </li> <li>Offshore wind power development is driving turbine sizes to 3-5 MW.</li> </ul>
<b>Economics</b>	<ul style="list-style-type: none"> <li>In the U.S., existing incentives such as the Production Tax Credit (PTC) enable onshore wind power to compete with conventional sources of power and are therefore critical to the financing of wind projects.                             <ul style="list-style-type: none"> <li>Ongoing cost reductions could potentially make onshore wind power competitive without incentives by beyond 2010 in the United States.</li> </ul> </li> <li>Offshore wind power is not competitive today despite the incentives and will continue to require government support.</li> <li>For smaller, customer-sited wind power, customers paying &gt;12¢/kWh for electricity that also have average wind speeds of 10 mph or more can expect a payback period of 8-16 years.</li> </ul>
<b>Markets</b>	<ul style="list-style-type: none"> <li>Global wind power installations during 2003 were ~8,300MW and are expected to grow at 5-8% p.a.</li> <li>Growth is being driven by steadily improving economics and government support worldwide. However, policy uncertainty in the U.S. (mainly around the PTC) has resulted in severe “boom-bust” cycles for markets despite the enormous potential for wind power.</li> </ul>
<b>Industry</b>	<ul style="list-style-type: none"> <li>Most major manufacturers of utility-scale turbines are European. GE Wind is the only major U.S. supplier</li> <li>A number of well-established and emerging project developer/owners exist in the United States.</li> <li>There are approximately a half dozen U.S. manufacturers, integrators and distributors of small wind turbines.</li> </ul>

## Solid biomass power is a relatively mature technology, that has not had the recent rapid growth of wind and PV, but interest is on the rise.

<b>Applications</b>	<ul style="list-style-type: none"> <li>• Most biomass power is installed as onsite industrial cogeneration, mainly in the pulp &amp; paper industry.</li> <li>• Other key applications include the use of agricultural residue for onsite power or stand-alone power.</li> <li>• The availability of forest residues from thinning operations could increase in the future and represent a relatively significant biomass resource in the Western states.</li> </ul>
<b>Technology</b>	<ul style="list-style-type: none"> <li>• Direct combustion remains the dominant technology, but with a shift to fluidized beds for newer installations. Development and deployment of “utility-scale” gasification technology continues to be gradual, with most utility-scale activity concentrated in Europe and in the US pulp &amp; paper industry.</li> <li>• Small-scale systems (combustion or gasification) are attracting more attention and development funding, due in part, to general increased interest in DG and the dispersed nature of much of the untapped existing biomass resources. This includes interest in integrating small gasifiers to reciprocating engines, microturbines and small gas turbines.</li> </ul>
<b>Economics</b>	<ul style="list-style-type: none"> <li>• Economics range considerably by technology, driven by differences in scale, fuel cost, and technology status.</li> <li>• Onsite cogeneration and biomass co-firing offer the most attractive economics.</li> <li>• Currently, direct-fired biomass combustion would produce electricity at 7-11 cents/kWh, depending upon biomass price. By 2008, BIGCC<sup>1</sup> would be able to produce electricity for 7-9 cents/kWh, depending upon the biomass price, with further declines possible, assuming the technology is successfully commercialized and more widely deployed.</li> </ul>
<b>Markets</b>	<ul style="list-style-type: none"> <li>• Approximately 21,000 MW installed worldwide: 6,000-7,000 MW in the United States<sup>2</sup></li> <li>• Focus has historically been on industrial biomass residues (pulp &amp; paper, cane sugar, food processing).</li> <li>• Co-firing with coal (direct firing and gasification) has received significant attention in the United States and Europe, and may “take-off” in near-term, driven in part by RPS that permit co-firing as an eligible option.</li> </ul>
<b>Industry</b>	<ul style="list-style-type: none"> <li>• The industry remains highly fragmented with no major merger &amp; acquisition activity.</li> <li>• Many equipment suppliers are serving specific markets.</li> <li>• Plant ownership is divided among a large number of industrials and utilities.</li> </ul>

1. Biomass integrated gasification combined cycle.

2. Approximations exclude waste-to-energy capacity and landfill gas/biogas. Landfill gas/biogas is addressed later.

## Photovoltaics (PV) is a mature technology that has experienced sustained double digit market growth, driven mainly by incentives.

<b>Applications</b>	<ul style="list-style-type: none"> <li>• Grid-connected applications and off-grid applications, with the former accounting for the majority of the market in 2003.</li> <li>• Grid-connected markets can be further divided into customer-sited and “central station”.</li> </ul>
<b>Technology</b>	<ul style="list-style-type: none"> <li>• Flat-plate PV dominates the market. Concentrating PV is in the demonstration phase and so-called nano solar is still in R&amp;D/early demonstration.</li> <li>• Flat-plate PV has over 25 years of proven and reliable performance in the field.</li> <li>• Crystalline silicon “wafer” technology has dominated the market for the past decade and is expected to continue to maintain this dominance in the near term.</li> <li>• Other technologies (mostly thin films) are in the early market penetration phase, although amorphous silicon has been in use for many years.</li> </ul>
<b>Economics</b>	<ul style="list-style-type: none"> <li>• PV system prices are expected to decline by about 5% per year over the next decade.</li> <li>• In favorable, high insolation areas, electricity from PV costs about are 30 - 35¢/kWh without any incentives.</li> <li>• Key incentives, where available in the United States can reduce the cost of electricity by close to 50%.</li> <li>• PV has the added advantage of being cost competitive today in many off-grid markets.</li> </ul>
<b>Markets</b>	<ul style="list-style-type: none"> <li>• The market for PV in the United States was approximately 70MW in 2003, 12% of global demand.</li> <li>• U.S. demand is expected to grow at approximately 20% p.a. in the future, driven mainly by state government incentive programs for grid-connected applications.</li> <li>• Globally, PV installations were approximately 600 MW in 2003 and are expected to be about 850MW in 2004. Europe and Japan are the largest markets.</li> </ul>
<b>Industry</b>	<ul style="list-style-type: none"> <li>• The top five firms (Sharp, BP Solar, Kyocera, Shell Solar and Sanyo) accounted for around 61% of the production of PV modules in 2003.</li> <li>• There is a growing infrastructure to support sales, installations, financing and service, but it is not uniform. It is most developed in regions/countries with the strongest and most consistent incentives.</li> </ul>

**PV can be sited at customer premises to compete with retail power, but high first cost is still a major barrier to broader market penetration.**

### Drivers

- Modular
- Well suited to customer-sited applications, at sufficiently high levels of market penetration has the potential to defer some T&D losses and upgrades.
- PV output is a good match with peak demand, thus offsetting the most expensive power.
- No land costs (if building mounted)
- Proven reliability
- Minimal O&M costs (no moving parts)
- Cost-effective today in many off-grid markets such as telecommunications, water pumping, cathodic protection, rural electrification. This is helping to justify larger manufacturing capacities, resulting in technology cost reductions.

### Barriers

- Very high capital costs relative to conventional power options and most retail electric rates
- Intermittent resource
  - Need energy storage to be able to operate completely independent of the grid
- Lack of infrastructure for sales/service (generally, but not in all regions)
- Poor consumer knowledge about the reliability of systems
- Aesthetics (for some consumers)
- Lack of simple interconnection agreements (this is not a disadvantage of PV itself, but rather a barrier to more widespread adoption)

## PV is not expected to be directly competitive with grid power for several years, but is expected to experience cost reductions of about 5% per year.

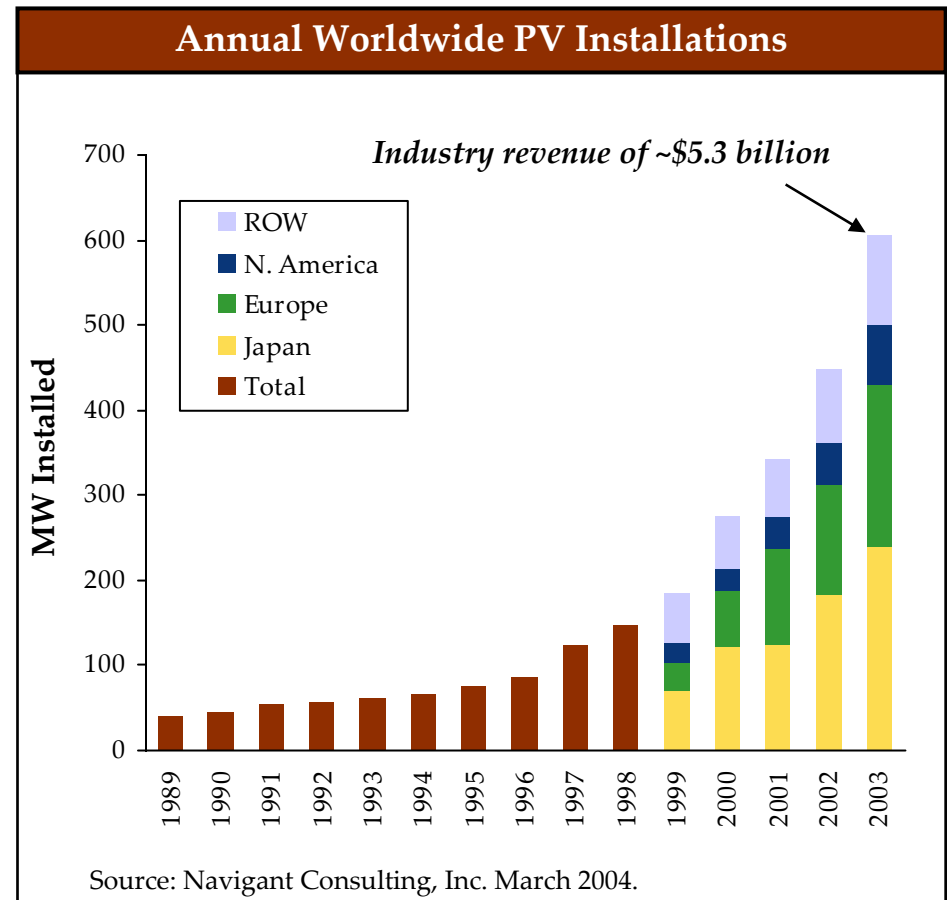
- Commercial building installations are typically on flat roof buildings.
- The annual energy output from PV systems ranges from 1,200-1,700 kWh per installed kWp, depending on insolation levels and field conditions.
- Total installed cost per kW is expected to drop from about \$8,000/kWpac in 2005 to \$3,700/kWac by 2020 for residential and \$6,500/kW to \$2,800/kW for commercial/central station
  - This does not assume technology breakthroughs that may occur.
- Incentives can reduce the cost of PV by more than 50% in the most attractive markets. The key incentive is the state-level rebate, with NJ and CA as good examples.
  - Federal tax-related incentives play a secondary role.

		“Typical” levelized cost of electricity for flat plate PV <sup>1</sup>		
		2005	2010	2020
Residential <sup>2</sup>	Total Installed Cost (\$/kW)	\$8,000	\$6,200	\$3,700
	LCOE - High Insolation (¢/kWh)	30-35¢	24-28¢	14-18¢
	LCOE - Moderate-Low Insolation (¢/kWh)	40-50¢	32-40¢	18-23¢
Commercial <sup>3</sup>	Total Installed Cost (\$/kW)	\$6,000	\$4,600	\$2,800
	LCOE - High Insolation (¢/kWh)	28-36¢	22-27¢	13-17¢
	LCOE - Moderate-Low Insolation (¢/kWh)	39-50¢	30-38¢	18-23¢
Central Station <sup>4</sup>	Total Installed Cost (\$/kW)	\$5,900	\$4,500	\$2,700
	LCOE - High Insolation (¢/kWh)	30-35¢	23-37¢	14-16¢

- The cost (¢/kWh) is the total lifecycle levelized cost of electricity. Ranges are illustrative and reflect several prior NCI analyses and covering a variety of economic assumptions. Values for Commercial and central station include the existing Federal accelerated depreciation and investment tax credits. The impacts of state-level incentives (e.g., rebates) would be in addition.
- Pitched roof.
- Flat roof.
- Single-axis tracking.

Since 1989, PV has grown at a compounded annual growth rate (CAGR) of 21%, reaching about 605 MW of annual installations in 2003; since 1999 the CAGR has been 34%.

- The global market has come to be dominated by Europe and Japan, driven by significant and consistent government support.
- US markets are a patchwork – PV markets are supported by a variety of state and utility programs and incentives, including green power/pricing, rebates and other incentives and Renewable Portfolio Standards.
  - Activity is highest in states or regions with rebates and RPS programs that have set-asides or tiers specifically for PV (e.g., CA, NJ, AZ)



**Concentrating PV (CPV) uses a lens or reflective collector to concentrate light (typically >100 suns) onto a very efficient solar cell.**

- The purpose is to raise output and efficiency by bringing more light to the solar cell, and reduce solar cell material requirements.
- While this increases the output per square foot or PV surface, it requires more expensive tracking systems, concentrating optics, and the need to cool the PV cell to prevent overheating. All of these raise costs and offset the benefits of higher output per cell.



Photo courtesy of Arizona Public Service, 2004: Prescott 35 kW, single axis tracking system.

## Concentrating PV (CPV) is an early stage technology that holds the promise of higher efficiency PV in the 2kW-5MW size range.

### Technology and Resource Availability

- CPV technology is in the prototype stage and under development at NREL, several universities, and some private companies.<sup>1</sup>
- Development needs include demonstrating performance reliability and 20 yr life in order to be competitive.<sup>2</sup> Typical prototypes today are in the 5kW-500 kW size range.
- European research is targeting use of GaAs cells.<sup>3</sup>
- Key U.S. players include United Innovations (high efficiency, high risk), Boeing SpectroLab (high efficiency multijunction, developmental), Amonix (silicon technology), and Concentrating Technologies Inc. (concentrating components).<sup>4,5</sup>

### Economic Issues

- At production volumes of 5MW/yr, silicon CPV could cost \$4/Wac. With efficiency improvements, the cost could drop to \$3/Wac,<sup>6</sup> but scale up is not likely until reliability is proven.
- NREL research is targeting cost reductions of all components, as well as integration.
- The Production Tax Credit (PTC), or the Renewable Energy Production Incentive (REPI) for municipal utilities, provides 1.8¢/kWh (2003 US\$) for 10 years of output. The PTC expired 12/2003, but has recently been extended through the end of 2005.

<sup>1</sup> [www.eere.energy.gov/solar/concentrator\\_systems.html](http://www.eere.energy.gov/solar/concentrator_systems.html), <sup>2</sup> Boeing Spectrolab interview, Aug 2004, <sup>3</sup> Fraunhofer Institute for Solar Energy Systems, June 2004 <sup>4</sup> Western Governors Association report, Jan 2002, <sup>5</sup> NREL presentation by Allen Lewandowski, May 2002, <sup>6</sup> "Solar Plants, Trackers, and CPV," ACC EPS Workshop presentation by Herb Hayden, APS, 4/5/2004

## Nano solar cells hold promise of low manufacturing costs, but reliability and stability still need to be proven for power applications.

### Technology and Resource Availability

- Nano solar technologies include dye sensitized solar cells (DSC), all-organic polymer, and inorganic/organic hybrids. Of these, only DSC is commercially available in limited quantities.
- All-polymer and hybrid technologies are 10-20 years from market entry
- Due to unique technology attributes such as light weight and conformability, these technologies will likely enter product-integrated electronics applications first.
- Published results on initial DSC cells demonstrate around 10% cell efficiency in the laboratory; all polymers and hybrids have achieved ~2-5% in the laboratory. Typical manufacturing efficiencies are half of this, and stability remains low.

### Economic Issues

- Manufacturers claim module costs as low as \$1/Wp for DSC relative to \$3/Wp for conventional PV. These have not yet been commercially realized.
- If cost targets are realized and a 10-year lifetime is achieved, nano solar would achieve a cost of electricity as low as 14¢/kWh, however, this cost is not likely to be achieved in the next several years.
- The technology performance and economics required for rooftop applications cannot be achieved by advanced solar cells in the near term.

# Agenda

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**III. RE Market Factors**

IV. RE Options for the Federal Sector

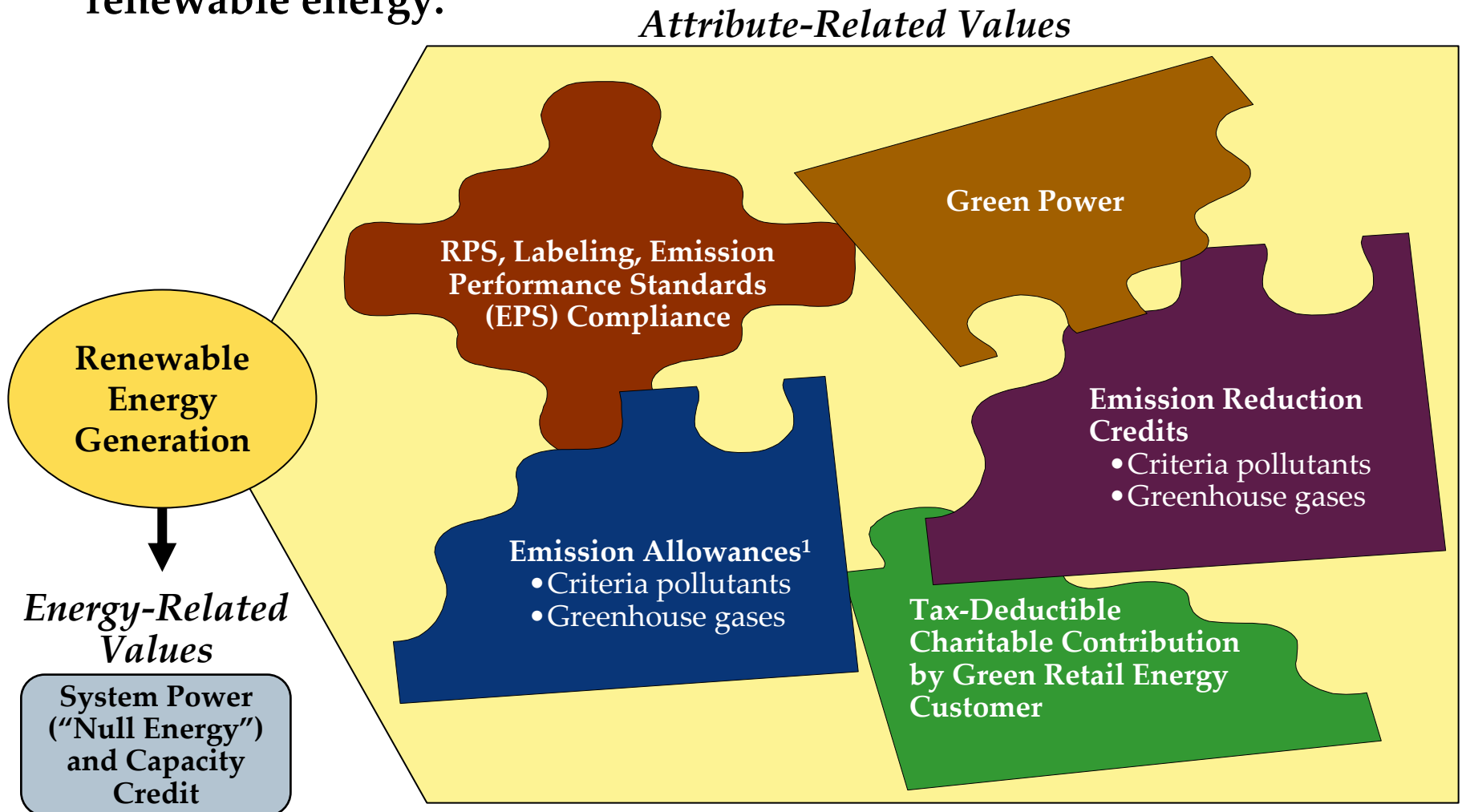
### **NCI reviewed the following market factors...**

- **Renewable Energy Attributes**
- **Renewable Portfolio Standards**
- **Renewable Energy Funds and other Incentives**
- **Voluntary Green Power Markets**
- **Other Considerations**

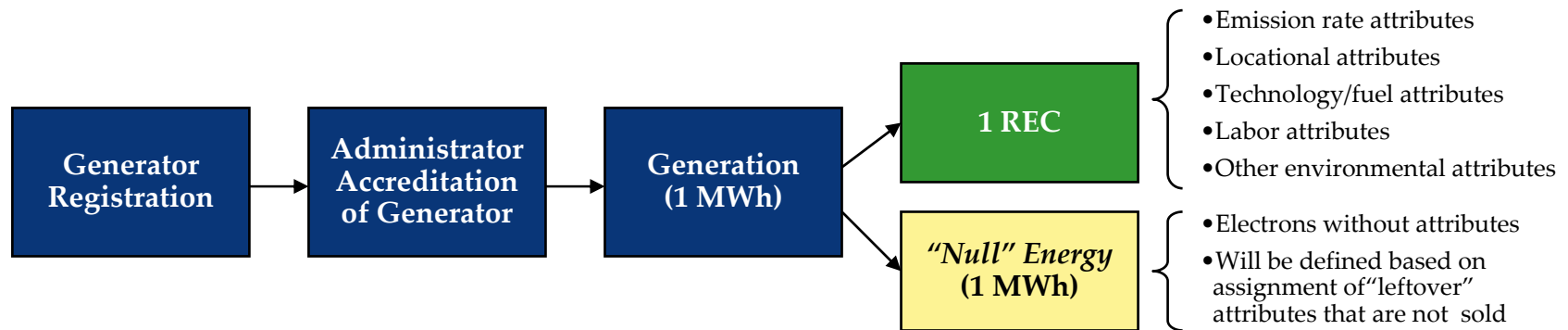
## **The market for RE in the United States is expected to remain robust, which creates challenges and opportunities for the Federal sector.**

- RPS, in place in 16 states (as of 12/2004), is resulting in significant demand for RE
  - At least 22 GW of new additions by 2017, plus support for another 8 GW of existing capacity.
  - Overall, RPS is expected to have mixed impacts on the Federal sector – on the one hand driving the development of the RE marketplace, but on the other hand creating “competition” for RE resources between RPS and other markets.
- Although smaller than the “compliance” markets (e.g., RPS), voluntary green power markets are also adding to RE demand. They give consumers the opportunity to purchase renewable energy through green pricing, green power marketing, and certificate products.
  - Competitive green power products are available in 9 states and in DC.
  - Tradable Renewable Energy Certificate (T-REC) products are available nationwide from ~ 30 suppliers.
  - Hundreds of utilities are active in green pricing programs in most U.S. states.
- Although the market can best be described as a patchwork, there are significant incentives in place at the Federal, state, and local levels.
  - State renewable energy Funds are expected to provide in excess of \$300 million in 2004 alone, with similar amounts in coming years.
  - The Federal sector can benefit directly by using the incentives, and indirectly by procuring RE products and services by private sector entities that can take advantage of these incentives.
  - There are about a dozen different types of incentives available to RE technologies targeted towards deployment (vs. RD&D).
- Several other factors, namely: high natural gas prices; increasing reliance on LNG imports; and mounting concerns over climate change, all favor RE development.

The market is beginning to value the non-energy related attributes of renewable energy.



## Renewable Energy Certificates (RECs) have emerged as a useful means for valuing the attributes of power sold to retail customers.

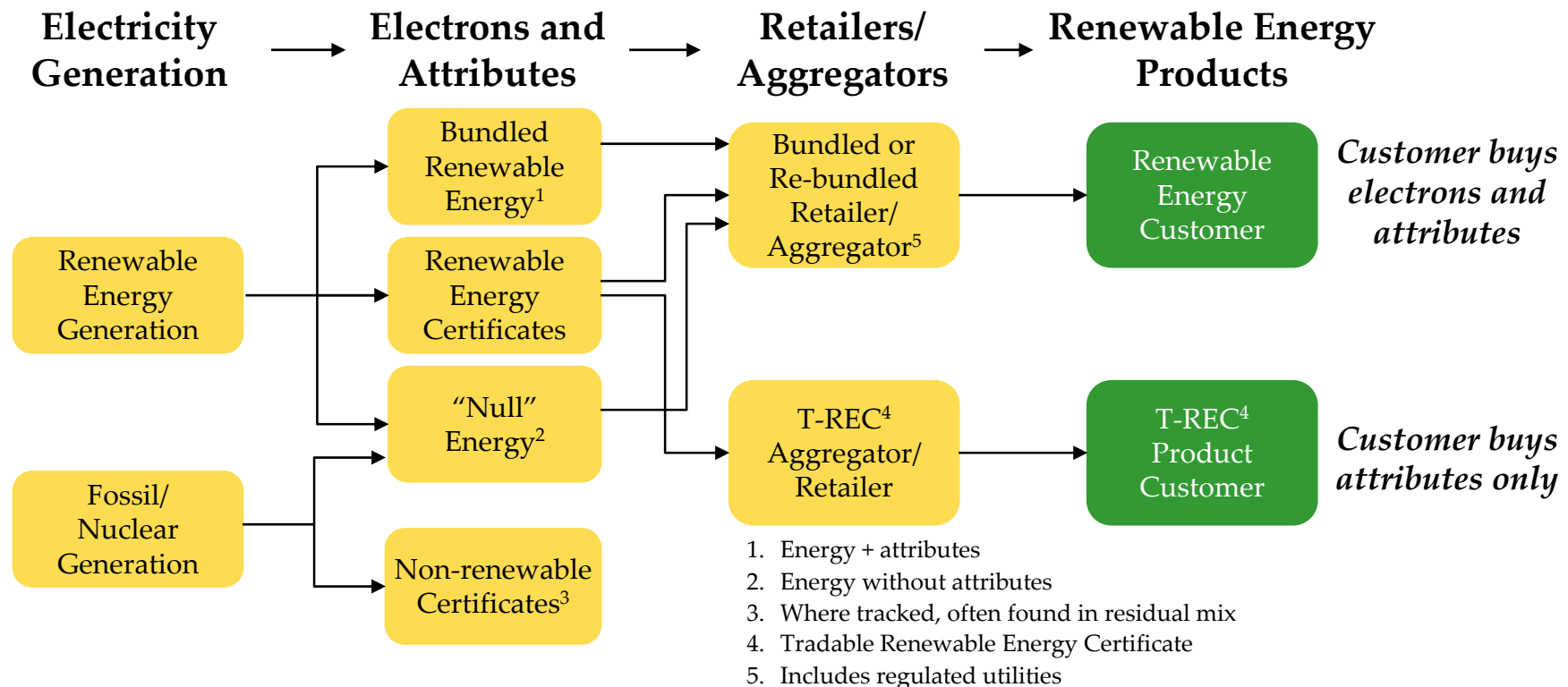


### RECs – Practical Considerations

RECs can support multiple regulatory and market needs: RPS, labeling, EPS (emissions performance standards), green marketing, and claim substantiation. RECs may also define tax-deductible, charitable contributions per the IRS and are also being used in countries with carbon/energy taxes on retail customers as a basis for retail tax exemption.

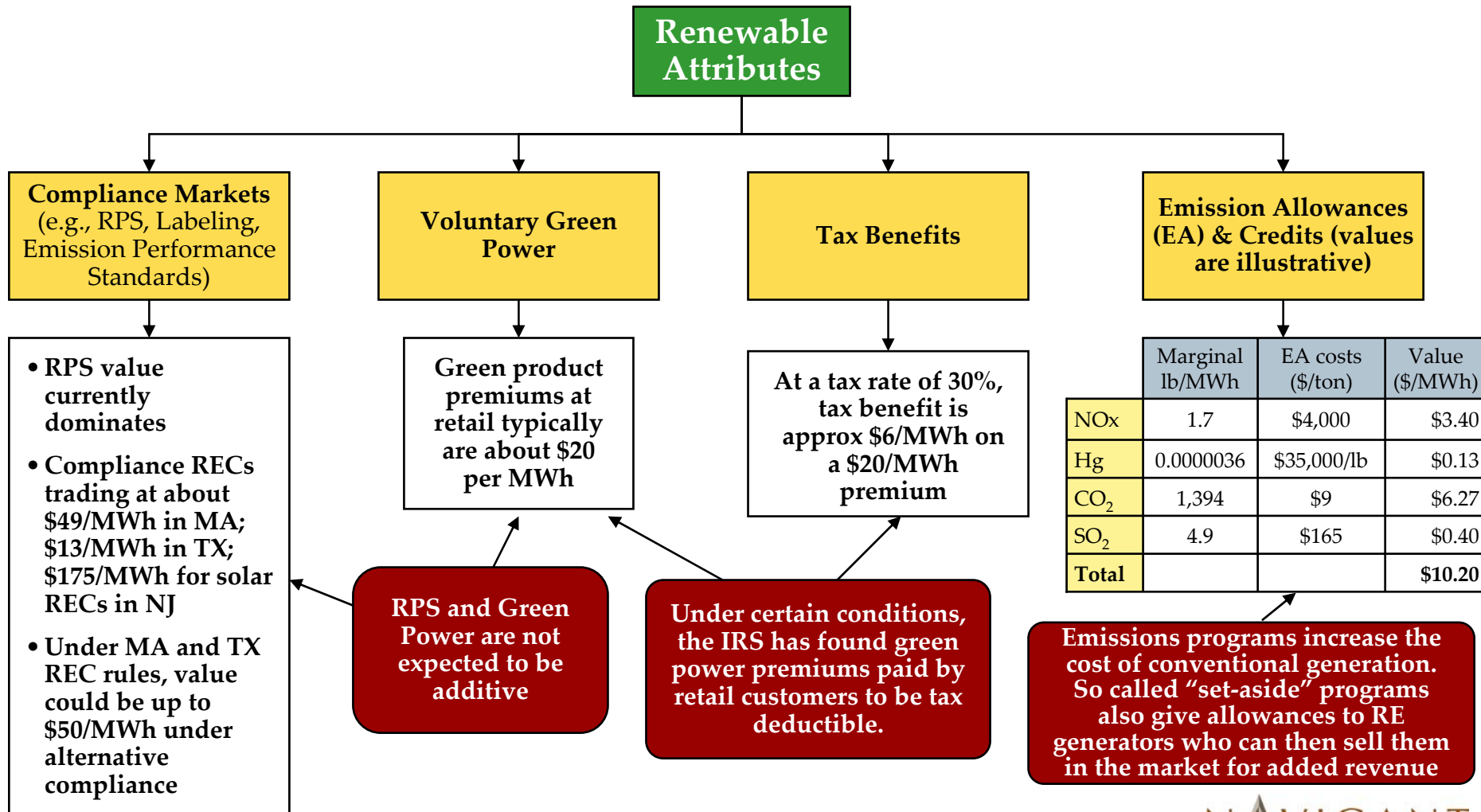
- An electronic certificate is issued to generators. Retail suppliers purchase RECs for RPS and other purposes.
- Settlement period – after RECs are issued, there is a defined period of time to trade them or lose them. Some systems are quarterly (New England GIS) and others are based on 12 months or longer. Banking provisions may allow RECs to remain viable for longer periods of time.
- RECs contain the attribute data necessary to support regulatory and market needs of each jurisdiction participating in the REC system.
- Government-accredited systems are now in operation in New England, Texas, Wisconsin, PJM (soon), Ontario (soon), the United Kingdom, and several other European Union countries.

There are two “green” energy products in the market: (1) renewable energy (bundled or re-bundled); and (2) tradable renewable energy certificates (T-RECs).



Both products can be used in either compliance and voluntary RE markets, depending on the specific market rules.

## Renewable energy attributes have at least four value components that can add \$10-50/MWh (1-5 ¢/kWh).



## RPS is expected to have mixed impacts on the Federal sector.

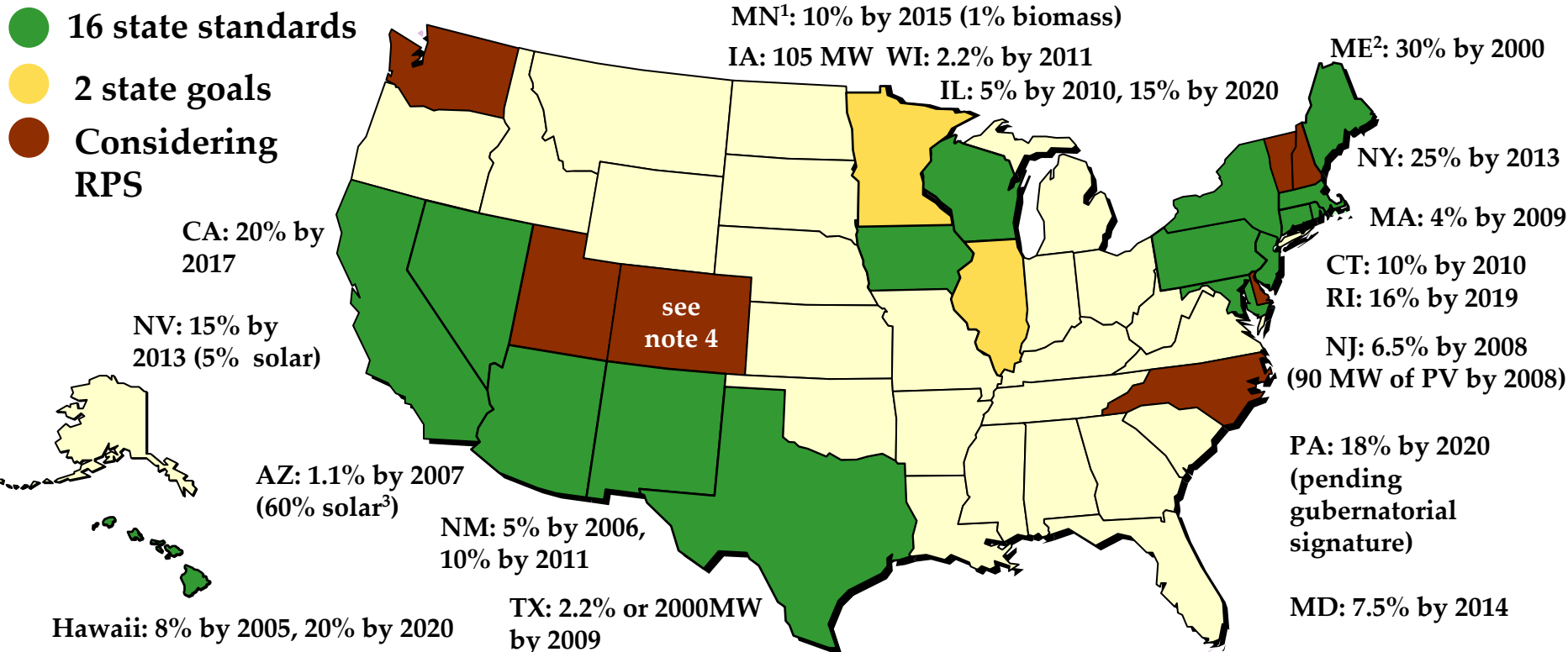
RPS Impacts	Benefits to Federal Sector	Challenges to Federal Sector
<b>RE Supply, Demand and Pricing</b>	<ul style="list-style-type: none"> <li>• N/A</li> </ul>	<ul style="list-style-type: none"> <li>• RPS eligible resources generally cannot also be counted towards other programs, either mandatory or voluntary.</li> <li>• As the largest source of demand for RE, RPS could constrain supplies of RE for non-RPS markets</li> <li>• If the market is supply constrained this will increase the price to Federal government of procuring RE or RECs</li> <li>• The patchwork nature of RPS means that different regions may experience constraints at different times.</li> </ul>
<b>RE Production Costs</b>	<ul style="list-style-type: none"> <li>• By increasing demand for RE, RPS should lead to cost reductions through economies of scale and by advancing the development of RE technologies</li> </ul>	<ul style="list-style-type: none"> <li>• As more RE is developed, the remaining resources will be more expensive (best resources get used first)</li> </ul>
<b>RE Infrastructure and Market Development</b>	<ul style="list-style-type: none"> <li>• RPS should lead to more robust sales, installation and service infrastructure for RE.</li> <li>• RPS should accelerate development of REC markets and financial services needed to serve RE markets in general.</li> </ul>	<ul style="list-style-type: none"> <li>• Infrastructure development will not be uniform throughout the United States.</li> <li>• If RPS “fizzles” (i.e., targets are not met), this could hurt development of RE for other purposes (e.g., REC markets seen as risky)</li> </ul>

**RPS programs seek to balance the expected incremental costs to ratepayers with the benefits of a cleaner environment, better use of resources and local economic development.**

Key RPS Drivers	Resulting RPS Design Elements
<b>Environmental Improvement</b>	<ul style="list-style-type: none"><li>• Preferences for certain resources viewed as more environmentally benign</li><li>• Geographic boundaries to keep air quality benefits local</li><li>• In some states, preferences for new capacity over existing capacity</li><li>• In other states, support for new and existing capacity to ensure continued operation of existing renewables</li></ul>
<b>Resource Optimization</b> <ul style="list-style-type: none"><li>• Increased energy supply diversity</li><li>• Reduced wholesale energy market volatility and average wholesale energy costs</li></ul>	<ul style="list-style-type: none"><li>• Promotion of both established and emerging renewable technologies</li><li>• Technology tiers to ensure diversity (e.g., set-aside amounts for customer-sited renewables)</li><li>• Most RPS programs seek to use the marketplace to deliver renewable energy in a cost effective manner, but least cost is not an explicit requirement of an RPS. Rather, in many cases, there is a cap on RPS costs (in the form of an alternative compliance payment) that limits the maximum exposure of ratepayers to higher energy costs.</li></ul>
<b>Local Economic Development</b>	<ul style="list-style-type: none"><li>• Geographic boundaries to ensure local employment benefits</li><li>• Leverage of renewable resource potential for export opportunities</li><li>• Maintaining the viability of existing power plants and related industries (e.g., pulp &amp; paper) to preserve employment and economic activity</li><li>• Create a sufficient market demand to lure major renewable equipment manufacturers to set up plants in-state</li></ul>

**While RPS programs seek to control total costs, the concept of “least cost” is not an overriding factor.**

**As of December 2004, 16 states had renewable portfolio standards and 2 others had renewable electricity “best effort” goals/targets.**

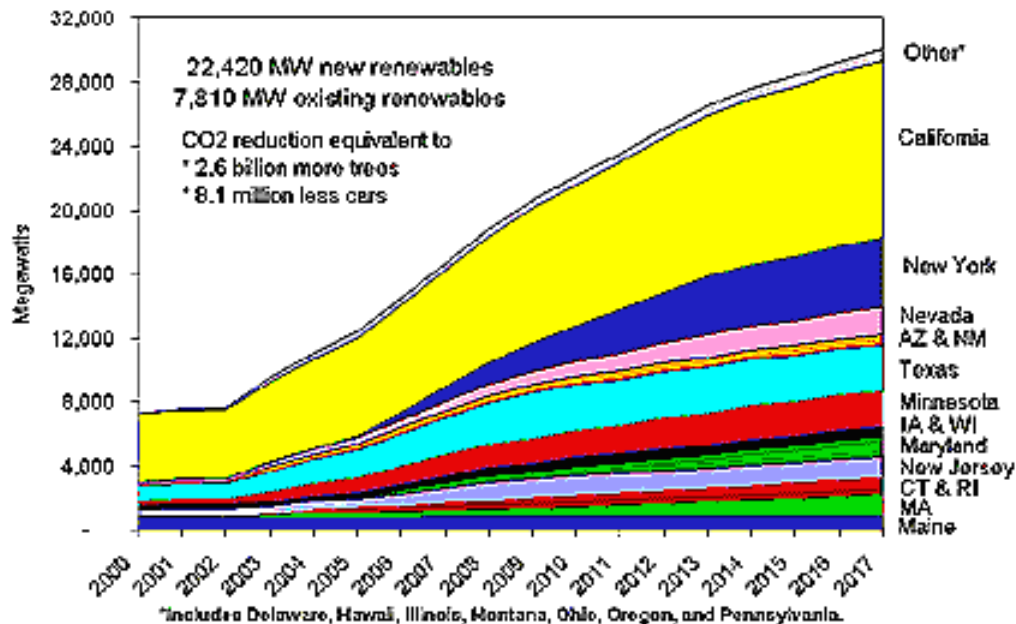


1. Not mandated, but a “good faith effort”. In addition, Xcel fulfilled (12/31/03) a mandate to procure/generate 425 MW of wind and are working on another provision to build or contract another 700 MW by 2010. Also, Xcel is contracting with St. Paul Plant for 37.5 MW of biomass. A poultry litter facility, Fibrominn, is being constructed in Benson, MN, which will generate 50 MW.
2. RPS includes existing resource and ME already exceeds the 30% target based on its definitions of qualifying resources.
3. RPS solar set aside is for solar electric technologies only. General RPS target would include solar hot water technologies as well.
4. RPS of 10% by 2015 passed by statewide ballot initiative. Details still to be worked out.

Source: Navigant Consulting, Inc. 2004.

State standards and funds are expected to result in the installation of more than 22,000 MW of new capacity by 2017.

## New and Existing Renewable Energy Capacity from State Standards and Funds



Source: Union of Concerned Scientists (as of November 2004):  
[www.ucsusa.org/clean\\_energy/renewable\\_energy/page.cfm?pageID=47](http://www.ucsusa.org/clean_energy/renewable_energy/page.cfm?pageID=47)

- State Standards and Funds are expected to create 30 GW of RE capacity by 2017.
  - Assuming a 50% average capacity factor, this represents ~130,000 GWh, or about 3% of the total projected electricity generation in the United States for 2017.

**Using four state RPS targets as benchmarks, a Federal sector goal of 10% would not create significant incremental demand for RE.**

		Comparison of State RPS programs to Federal RE requirements											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2020
MA <sup>1</sup>	% sales	1.0%	1.5%	2.0%	2.5%	3.0%	3.5%	4.0%	5.0%	6.0%	7.0%	8.0%	15.0%
	GWh	518	798	1,089	1,394	1,709	2,042	2,386	3,051	3,745	4,468	5,226	11,527
NY <sup>1</sup>	% sales				0.96%	1.95%	2.94%	3.90%	4.86%	5.83%	6.76%	7.71%	N/A
	GWh				1,360	2,822	4,306	5,788	7,302	8,867	10,404	11,989	N/A
NJ <sup>2</sup>	% sales		3.25%	3.5%	4.5%	5.5%	6.5%						20%
	GWh		2,353	2,562	3,321	4,103	4,901						16,832
CA <sup>3</sup>	% sales	13.6%	14.4%	15.3%	16.1%	16.9%	17.8%	18.6%	19.4%	20.2%	21.0%	21.7%	27.0%
	GWh	21,253	22,821	24,404	26,003	27,618	29,249	30,897	32,561	34,242	35,939	37,654	50,145
Fed	%			2.5%	2.8%	3.0%	3.7%	4.3%	5.0%	5.8%	6.7%	7.5%	10.0%
	GWh			1,375	1,513	1,650	2,013	2,382	2,750	3,207	3,663	4,125	5,500

1. Figures for MA and NY show “new” renewable electricity generation only (generation from renewable energy plants that existed before the RPS are not included). Current NY RPS only goes to 2013. MA statute has the RPS increasing by 1% per year.
2. NJ figures include existing renewable capacity, which accounts for 2.5% of electricity generation. 20% by 2020 is proposed.
3. California figures for 2005 and beyond are estimates. The RPS requires the 3 California utilities to increase their renewable electricity generation each year by an amount equal to 1% of the previous year’s total electricity generation; therefore, RPS requirements cannot be determined in advance, and the current RPS only specifies the RE generation requirement for 2004. The estimates shown here are based on the assumption that total electricity sales in the State would go up by 1% per year.

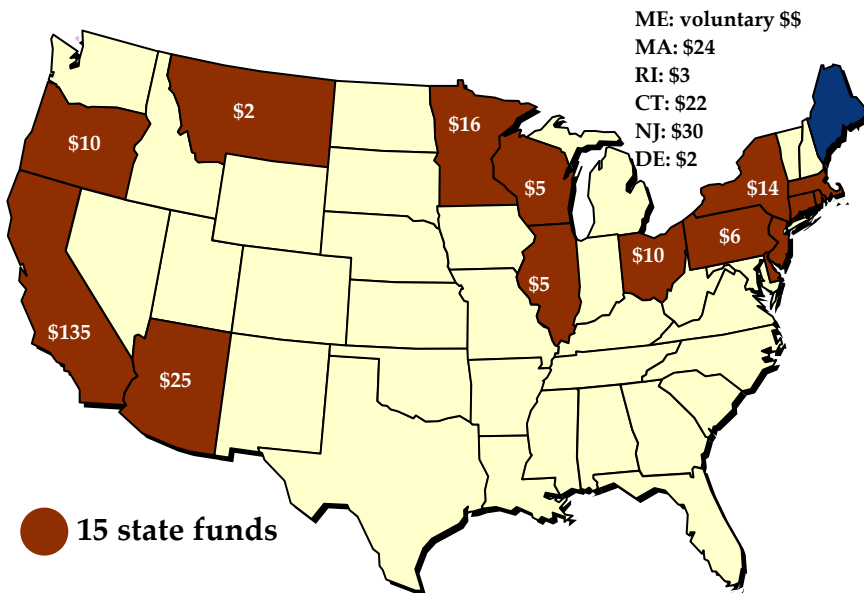
**State RE Funds, which are targeted mainly at reducing RE costs and facilitating market development, should benefit the Federal sector.**

RE Fund Impacts	Benefits to Federal Sector	Challenges to Federal Sector
<b>RE Supply, Demand and Pricing</b>	<ul style="list-style-type: none"><li>• State RE funds should lead to greater overall RE supply.</li></ul>	<ul style="list-style-type: none"><li>• In states with both an RPS and a Fund, much of the targeted RE development may go towards RPS compliance.</li></ul>
<b>RE Production Costs</b>	<ul style="list-style-type: none"><li>• Helps lower the cost of RE through rebates and other incentives.</li></ul>	<ul style="list-style-type: none"><li>• N/A</li></ul>
<b>RE Infrastructure and Market Development</b>	<ul style="list-style-type: none"><li>• Some RE fund programs are targeted directly at infrastructure development. All RE customers should benefit.</li><li>• Increasingly, state RE funds are exploring ways they can facilitate RE market development, including green power and REC markets.</li></ul>	<ul style="list-style-type: none"><li>• Infrastructure development will not be uniform throughout the United States.</li><li>• Market development activities may be focused on RPS compliance and not on voluntary RE markets.</li></ul>

**The wide variation in programs requires the Federal sector to track and understand a large number of programs and opportunities.**

State renewable energy funds are expected to provide in excess of \$300 million for renewables in 2004 alone.

**U.S. Renewable Energy Funds (as of 10/04)  
(Annual funding available 2004, in million \$)**



Note: values show annual amounts for RE only.

	Wind	Solar	Geothermal	Biomass	Landfill Gas	Ocean-based	Hydro	Fuel Cells	MSW
MA	●	●		●	●	●	●	●	●
RI	●	●		●			●	●	
CT	●	●		●	●	●		●	
NY	●	●	●	●			●	●	
NJ	●	●	●	●	●		●	●	
PA	●	●	●	●	●		●	●	●
DE	●	●	●						
OH	●	●	●	●			●	●	
IL	●	●		●			●		
WI	●	●	●	●	●		●	●	
MN	●	●		●			●	●	
MT	●	●	●	●			●		
AZ	●	●		●	●				
OR	●	●	●	●	●		●	●	●
CA	●	●	●	●	●	●	●	●	●

**Various financial incentives serve to reduce to the cost of renewable energy, and therefore benefit the Federal sector, even if the Federal sector is not directly eligible for them (e.g., tax credits).**

Other Incentive Impacts	Benefits to Federal Sector	Challenges to Federal Sector
<b>RE Supply, Demand and Pricing</b>	<ul style="list-style-type: none"> <li>• By reducing costs, incentives lead to more RE development, thereby increasing supply and lowering the prices paid.</li> </ul>	<ul style="list-style-type: none"> <li>• N/A</li> </ul>
<b>RE Production Costs</b>	<ul style="list-style-type: none"> <li>• Incentives lead directly to lower costs</li> </ul>	<ul style="list-style-type: none"> <li>• Many incentives are based on the tax code and are therefore not directly available to the Federal sector.</li> </ul>
<b>RE Infrastructure and Market Development</b>	<ul style="list-style-type: none"> <li>• Some incentives may be targeted specifically at infrastructure development. In general however, any incentive that increases the use of RE should result in better infrastructure over time.</li> <li>• Incentives are not typically targeted directly at market development, but market issues (e.g., robustness of REC markets, RE financing) are increasingly the focus of various incentives, policies and programs.</li> </ul>	<ul style="list-style-type: none"> <li>• Infrastructure development will not be uniform throughout the United States.</li> </ul>

## The Federal government has historically used four basic types of incentives to support RE, but not all apply to all technologies.

Incentive	Description	Applicability					
		PV	Solar Thermal Electric	Wind	Biomass/LFG	Low-Impact Hydro	Geo-thermal
<b>Production Tax Credit (PTC)</b>	<ul style="list-style-type: none"> <li>1.8 ¢/kWh, after tax, for first 10 years of operation. PTC is indexed to inflation and is good through 1/1/2006.</li> <li>Full value applies to wind, solar, geothermal and “closed-loop” biomass</li> <li>Credit value and credit period is reduced by half for “open-loop” biomass, small irrigation power and waste to energy</li> </ul>	✓	✓	✓	✓	Small irrigation power only between 150kW and 5MW	✓
<b>Investment tax credit</b>	<ul style="list-style-type: none"> <li>10% of the investment purchase/installation on income tax up a maximum of \$25,000/yr plus 25% of remaining tax (15 yr. term in addition to 3 preceding yrs. if applicable)</li> </ul>	✓	✓				✓
<b>Accelerated Depreciation</b>	<ul style="list-style-type: none"> <li>Eligible technologies are classified under Modified Accelerated Cost Recovery System (MACRS) property class 5, allowing 5-year vs. 15 year depreciation</li> </ul>	✓	✓	✓			✓
<b>Renewable Energy Production Incentive (REPI)</b>	<ul style="list-style-type: none"> <li>Rough equivalent to the PTC but for municipal utilities and other public entities</li> <li>1.51¢/kWh (1993\$) for the first ten years of operation.<sup>3</sup></li> </ul>	✓	✓	✓	✓ <sup>1</sup>		✓ <sup>2</sup>

1. Contains restrictions on “closed loop” vs. “open loop” biomass, such that most biomass projects do not qualify under current rules.

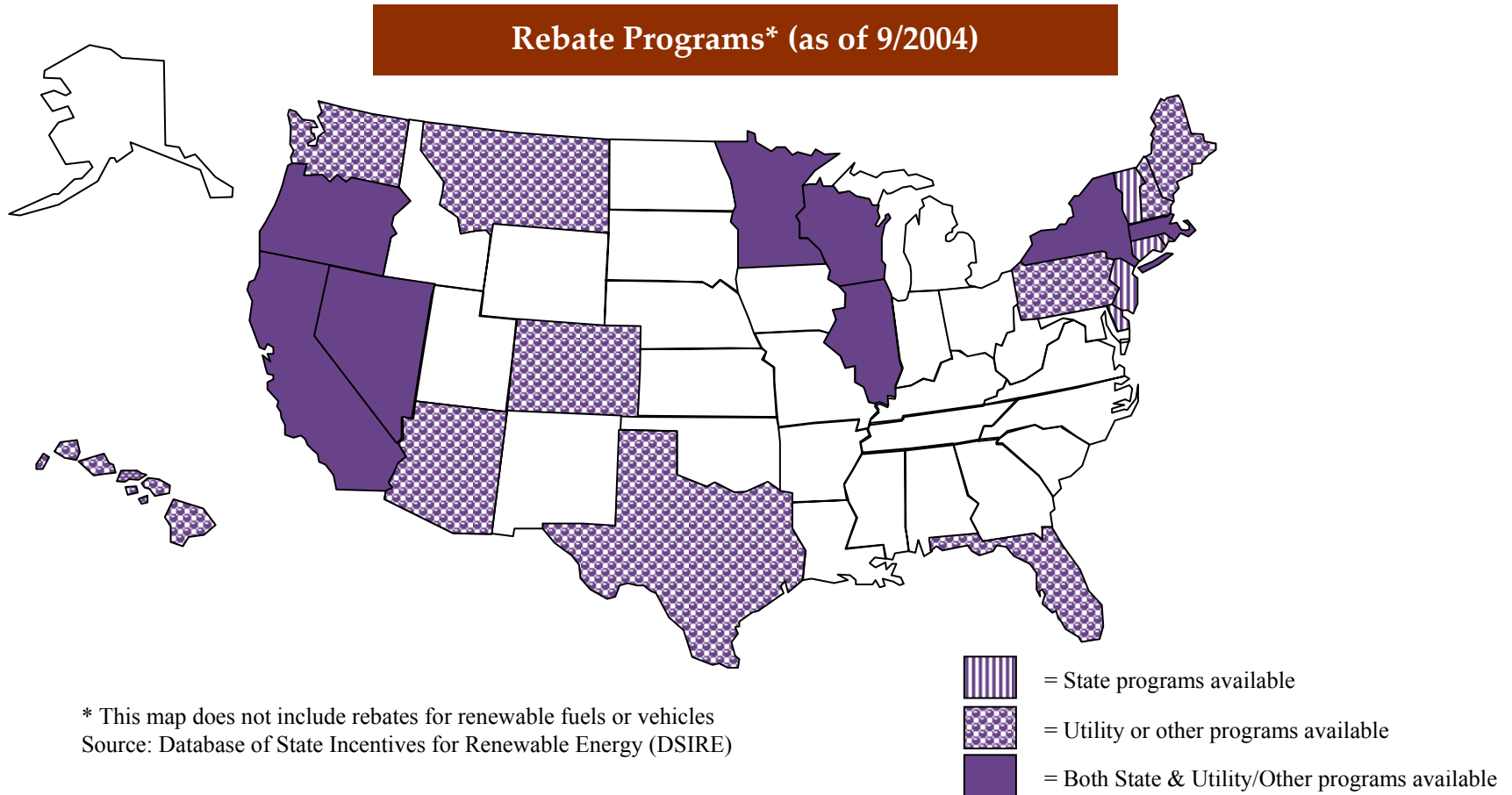
2. Contains restrictions on the type of geothermal reservoir.

3. The REPI is subject to annual appropriations such that it may not be fully funded from year to year.

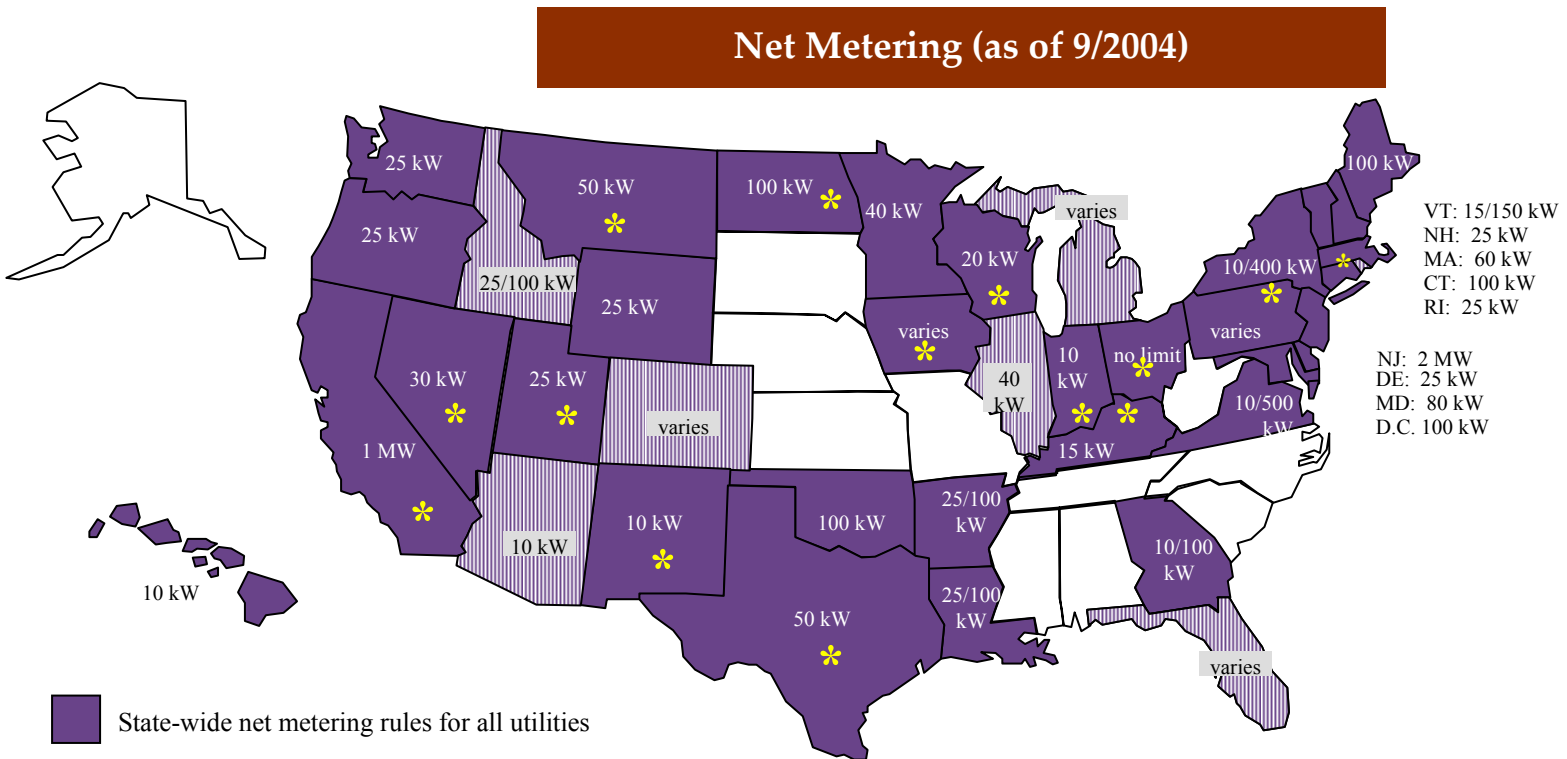
**Individual states and municipalities also provide a wide range of RE incentives, the most common of which are rebates, tax exemptions, and tax credits.**




Most common state/municipal incentives	Description	Typical Applicability (not based on an exhaustive assessment)					
		PV	Solar Thermal Electric	Wind	Biomass/LFG	Low-Impact Hydro	Geo-thermal
<b>Rebates on installed costs</b>	<ul style="list-style-type: none"> <li>• \$2-5/Watt typical for PV</li> <li>• Can be lower for other technologies</li> <li>• Also subject to absolute or percent limits (e.g., \$4/Watt up to 60% of system price)</li> </ul>	✓		✓	✓		
<b>Property and sales tax exemptions</b>	<ul style="list-style-type: none"> <li>• Full or partial exemption from paying property and/or sales tax on qualifying systems/technologies</li> </ul>	✓	✓	✓	✓	✓	
<b>Income tax credits</b>	<ul style="list-style-type: none"> <li>• Schemes vary: <ul style="list-style-type: none"> <li>— May be for one or more years</li> <li>— May be based on production or initial price</li> <li>— Typically have total dollar limits</li> </ul> </li> </ul>	✓	✓	✓		✓	

Since rebates can have a significant impact on RE economics, several state funds support them, in addition to rebates available through utilities.



## Thirty-eight states currently have net metering regulations, mostly for technologies smaller than 25kW.



-  State-wide net metering rules for all utilities
-  State-wide net metering rules only for certain utility types (e.g., IOUs only)  
In these cases, other utilities (e.g., municipal utilities, cooperatives) may have different rules.
-  Net metering offered by one or more individual utilities

# kW indicates limit on system size; in some cases, limits vary by customer type.

Source: Database of State Incentives for Renewable Energy (DSIRE)

## **The Western Governors Association adopted a resolution to explore opportunities to expand the use of renewables in Western States.**

- Resolution 04-14 “Clean and Diversified Energy Initiative for the West” was adopted at the June 2004 Annual Meeting. The resolution builds upon recommendations the governors received from the nearly 700 participants at the North American Energy Summit, which WGA held in April 2004.
- The resolution notably calls for Western Governors to “examine the feasibility of and actions that would be needed to achieve a goal to develop 30,000 MW of clean energy in the West by 2015 from resources such as energy efficiency, solar, wind, geothermal, biomass, clean coal technologies, and advanced natural gas technologies.”
- The resolution does not set a specific RPS or similar binding target. Rather, it creates a new working group, The Clean and Diversified Energy Working Group (CDEWG), that will determine how to reach the 30,000 MW goal, as well as other objectives set forth in Resolution 04-14.
- Recommendations made by the CDEWG are meant to help the member states design energy policies that will achieve WGA goals. There is no separate RPS in addition to the RPS adopted by the individual states.
- Given the early status of the initiative, it is difficult to assess the impact on the Federal sector, but the benefits are likely to outweigh the challenges, e.g.:
  - If the goal is an overlap to existing and future state RPS targets and not an incremental requirement, then the Federal sector should be able to participate toward achieving the goal;
  - If implemented, the initiative will likely include activities to improve transmission capacity, facilitate permitting and remove other barriers to RE development; and
  - The ability to track and trade RE attributes would likely be improved.

Source: [www.westgov.org/wga\\_energy.htm](http://www.westgov.org/wga_energy.htm)

## Further development of voluntary green power markets should benefit the Federal sector.

Green Power Impacts	Benefits to Federal Sector	Challenges to Federal Sector
<b>RE Supply, Demand and Pricing</b>	<ul style="list-style-type: none"><li>• Green power is a primary option for RE supply, but supply will only grow to meet anticipated demand.</li><li>• Green power can be a good hedge against electricity price volatility by replacing electric purchases that are subject to fuel adjustment charges (some utility green pricing specifically targets commercial customers with this type of benefit)</li></ul>	<ul style="list-style-type: none"><li>• Green power represents an incremental cost to the Federal sector.</li></ul>
<b>RE Production Costs</b>	<ul style="list-style-type: none"><li>• By allowing the marketplace to work, increased use of RE for green power should lead to cost reductions through economies of scale.</li></ul>	<ul style="list-style-type: none"><li>• As more RE is developed, the remaining resources will be more expensive (best resources used first).</li></ul>
<b>RE Infrastructure and Market Development</b>	<ul style="list-style-type: none"><li>• Green power development contributes to RE infrastructure development.</li><li>• Green power development contributes to the development of robust RE markets that are not policy driven.</li></ul>	<ul style="list-style-type: none"><li>• In the near term, most infrastructure development from green power may be for wind and landfill gas, which will not help PV, and it is PV that is most widely deployable for onsite RE for the Federal sector.</li></ul>

**As of the end of 2003, nearly 1,650 MW of RE capacity was serving U.S. green power markets, with nearly 400 MW to be added shortly.**

New <sup>1</sup> Renewable Capacity Supplying Green Pricing Power Markets				
Source	MW in place	%	MW Planned <sup>2</sup>	%
Wind	1,544.6	93.8	306.7	78.0
Biomass	77.4	4.7	60.3	15.3
Solar	5.6	0.3	1.3	0.3
Geothermal	10.5	0.6	25.0	6.4
Small Hydro	9.3	0.6	0.0	0.0
<b>Total</b>	<b>1,647.3</b>	<b>100.0</b>	<b>393.4</b>	<b>100.0</b>

1. New capacity refers to projects built specifically to serve green power customers or recently constructed to meet Green-e standards and used to supply green power customers. Includes both utility green pricing and competitive green power products. Capacity installed to meet state RPS requirements are not included.
2. Planned means under construction or formally announced.

Source: DOE - EERE Green Power Network

Federal Renewable Electricity Consumption (% is fraction of Federal sector electricity use)				
Renewable Electricity Target	2007	2010	2013	2020
• Annual RE consumption (GWh) <sup>1</sup>	1,650 (3%)	2,750 (5%)	4,125 (7.5%)	5,500 (10%)
• Estimated <sup>2</sup> installed capacity (MW)	375	630	940	1,255

1. RE targets as in HR 4503, as of 6/17/2004 (see <http://thomas.loc.gov/>). The 10% target for 2020 is hypothetical. The GWh figures assume no growth in total federal sector energy consumption. See also McNeil Technologies, "Analysis for Developing a New Federal Renewable Energy Goal", September 2004.

2. Assuming an average capacity factor of 50%

**RE capacity required to meet 10% of Federal sector electricity consumption is roughly equal to current and planned green power market capacity.**

## The Federal sector must also consider a range of other factors affecting renewable energy technologies and markets.

Other Considerations	Comments
<b>Natural Gas/LNG Supply and Pricing</b>	<ul style="list-style-type: none"><li>• Tight natural gas supplies and an increasing reliance on LNG imports should help renewables in the coming years, by maintaining high prices for natural gas.</li></ul>
<b>Potential for a Federal RPS<sup>1</sup></b>	<ul style="list-style-type: none"><li>• A Federal RPS would bring greater uniformity in RE use across the country and could potentially lead to a very significant expansion in RE.</li></ul>
<b>Emissions Trading</b>	<ul style="list-style-type: none"><li>• In general, emissions regulations increase the cost of conventional generation, which makes RE more competitive. However, emission trading needs to be carefully considered for its impact on REC markets, as they relate to the issue of unbundling certain RE attributes.</li></ul>
<b>Energy Efficiency</b>	<ul style="list-style-type: none"><li>• Increased energy efficiency, whether at Federal facilities or in the nation at large (e.g., as a result of efficiency standards), would make it easier to reach Federal RE targets.</li><li>• The former would make a given RE target achievable with fewer kWh and the latter would free up more renewables resources for purchase by making other RE targets (e.g., state RPS) easier to meet.</li></ul>

1. This would be a Federal requirement that the entire United States be subject to an RPS. It is different from, and presumably would not affect, any Federal sector RE purchase requirements.

# Agenda

I. Introduction

II. Renewable Energy Technology Outlook

III. RE Market Factors

**IV. RE Options for the Federal Sector**

## Seen in the context of the larger market, even a 10% Federal RE target is expected to be relatively small and should be achievable by 2020.

- Current RPS requirements and state renewable energy funds are expected to result in approximately 22,000 MW of new RE capacity by 2017
- To date, utility green pricing programs and competitive green power markets have led to the development of more than 1,600 MW of new RE capacity with another 400 MW planned (under construction or formally announced)
- In comparison, the table below provides an estimate of the Federal sector RE consumption for different levels of RE.
  - By way of further comparison, the new NY RPS would require that state to generate approximately 12,000 GWh/year from new renewables by 2013.

	Federal Renewable Electricity Consumption			
	2007	2010	2013	2020 (hypothetical)
% RE in Federal Consumption	3%	5%	7.5%	10%
Estimated Annual Federal RE Consumption (GWh)	1,650	2,750	4,125	5,500
Estimated installed capacity (MW @ 50% average capacity factor)	375	630	940	1,255
Federal RE consumption as % of total U.S. non-hydro RE generation	1.5%	1.9%	2.5%	2.8%

Sources: EIA, *Annual Energy Outlook 2004*; EIA, *Analysis for Developing a New Federal Renewable Energy Goal*, September 2004.

## The Federal government has several options for buying RE power or building its own RE.

### Buy Options

- Buy options can be, but do not need to be, technology specific. Most choices involve purchasing some form of green power or renewable energy certificate product.
- Bundled Renewable Energy
  - Competitive green power markets
  - Utility green pricing
- Voluntary Renewable Energy Certificates (RECs)
- Joint Powers Agency (collective buying power with non-Federal entities)
- Facilitate development by Independent Power Producers (e.g., land for REC swap)

### Build Options

- Most build opportunities will likely be for PV, but in some cases may include wind power, geothermal power and biomass, depending on the Federal agency.
- Once a technology has been selected, build options relate mainly to the means of financing:
  - Energy Savings Performance Contracts
  - Enhanced Use Leasing
  - Utility Energy Savings Contracts/Area-wide Agreements
  - Utilities Privatization
    - Consider RE as condition of sale
  - Energy Conservation Investment Program/Direct Appropriation
  - RE Demonstration Project

## Renewable energy “Buy” options are among the government’s best choice because of their broad applicability and (generally) lower cost.

- Any agency can buy RECs, individually or through GSA or DESC; however, RECs are not budgeted as an energy expense and may not be as attractive as a direct purchase of green power as a long-term solution.
  - Purchasing bundled green power can offset electricity price volatility due to fuel price changes, whereas REC-only purchases are in addition to the utility bill.
- As the RE marketplace matures, there should be more choices for procuring RE products, either as bundled renewable energy (green power/pricing) or as RE certificates.
- Availability of green power is limited to deregulated markets and varies state by state; however, several mechanisms are being developed to extend its reach:
  - Agencies in WAPA territory can purchase green power in one state for delivery in another
  - The Air Force is working to buy wind power in West Virginia for delivery to military installations through the PJM grid
- Aggregation of facilities for purchase of green power works best regionally or by utility. Geographic aggregation that crosses utility jurisdictions almost never works.
- Assuming that direct procurement of RE or RECs is the main means of meeting any future goal, a key issue for the Federal sector will be the price for this power, which will be partly determined by the overall supply/demand balance of RE. This will be strongly influenced by RPS requirements.
  - However, even setting reasonably aggressive RE targets for the Federal sector is not likely to upset basic supply/demand issues in RE markets overall.

## **“Build” options can also result in economically sound RE development, but have limited applicability relative to “buy” options.**

- Siting RE at Federal facilities requires alignment of a complex series of factors:
  - Available renewable energy resource
  - Usable physical location (land, rooftop, building, etc.)
  - Adequate utility infrastructure
  - Ability to mitigate or accommodate variability in output
  - Favorable environmental conditions
  - Agency interest and technical capability
- For electricity generation, most RE build options will be limited to PV
  - PV cost will limit overall deployment
  - However, PV can generally be applied at any facility
  - Federal facilities with suitable land and resources could also deploy small wind systems and in some cases small onsite biomass power systems
- For military installations, government ownership and operation of a power plant runs counter to utilities privatization.
- Nevertheless, there are a number of states that are actively promoting the use of onsite renewable energy through a variety of incentives, and the Federal sector should focus on these states.
- The Federal sector could consider establishing a revolving fund for financing RE projects
  - A portion of energy savings could be set aside to create the fund. Funding could then be awarded through a bidding process.

## **The Federal sector should have a clear picture of best build opportunities and strategically plan to maximize return on investment.**

- The Federal sector should consider developing a comprehensive picture of the RE potential at civilian facilities, similar to what is being developed by the military.<sup>1</sup>
  - Overlay facility location, characteristics and type with:
    - RE resource potential
    - State RE incentive programs
- The Federal sector may want to require that all new construction or major renovation projects include an assessment of onsite RE options.
  - This could include Federal facilities and other Federal activities, such as Federally supported housing
- Since many of these projects could have relatively long paybacks, the Federal sector should also consider the long-term disposition of the facility.
- The analysis could consider how well the RE option is aligned with the mission of the facility or Agency.
  - E.g., onsite RE generation could support reliability requirements, showcase a particular technology or displace fuel requirements for remote, off-grid sites.
- The above process would generate a comprehensive picture of the best RE build options for the Federal sector.

1. In 2002, funding was set aside by Congress to assess the renewable energy potential of U.S. military installations. The Department of Defense (DoD) created a Renewable Energy Assessment Team to explore solar, wind and geothermal energy resources at military installations.

## Careful consideration must be given to the disposition of RECs created by onsite renewable energy generation at Federal agencies.

### The Issue

- The emergence of RECs means that there is a new value stream created from renewable energy that is generated onsite at Federal facilities.
- Sale of these RECs, especially solar RECs, can create significant value for an onsite RE project.

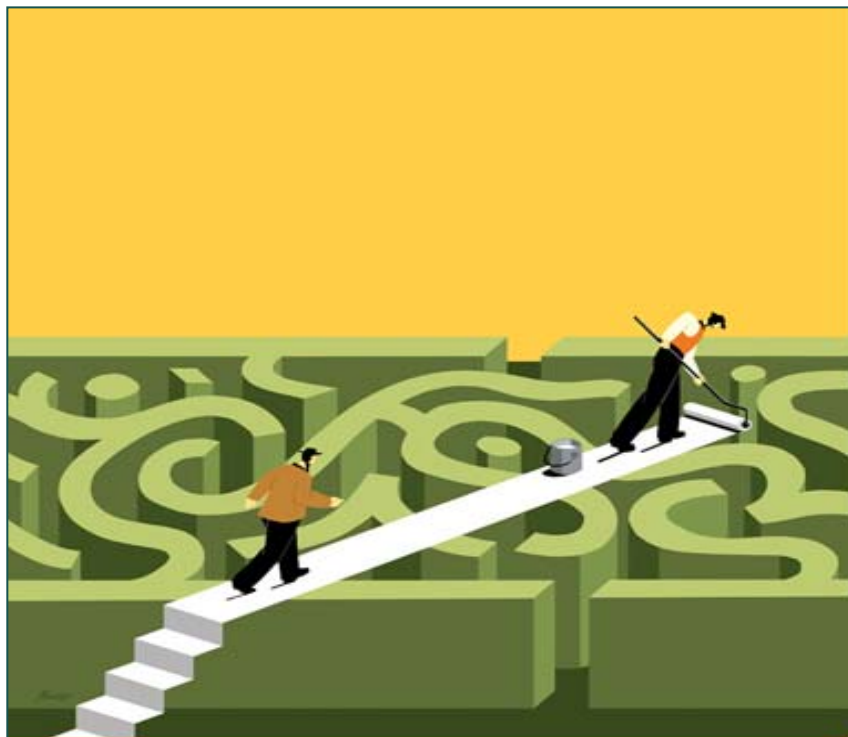
### The Complication

- If the RECs are sold, then the Federal government no longer retains the attributes of the renewable energy, and therefore cannot count the generation towards its own RE targets.
  - Only the person/entity that buys/retains (or “retires”) the REC can claim to own the attributes. Otherwise the same attributes will be counted twice, which would undermine the validity of the REC market.

### The Solution

- Voluntary RECs from qualifying sources are available for purchase at relatively low prices (often less than 1¢/kWh). At the same time, the Federal sector may have RECs to sell at higher prices (e.g., from onsite PV systems, which typically are valued in the range of 10¢/kWh).
- Thus, if the Federal sector can sell its high-value RECs and buy a matching number of less expensive RECs, there is still a net financial benefit and the agency can still justifiably claim to be supporting local renewable energy generation, and the onsite generation effectively contributes to the Federal sector targets.
  - In fact, by both buying and selling RECs, an argument could be made that this approach further supports the robustness of the renewable energy marketplace by increasing the volume of transactions.

## Contact Us



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